Page 5: Guidelines for Canadian Drinking Water Quality: Guideline Technical Document – Turbidity

Previous Page | Table of Contents | Next Page

Part II. Science and Technical Considerations

4.0 Identity and sources in the environment

4.1 Description of turbidity

Turbidity is a measure of the relative clarity or cloudiness of water. The turbidity of filtered water is usually measured in nephelometric turbidity units (NTU), using a device called a turbidimeter. Turbidity is not a direct measure of suspended particles, but rather a general measure of the scattering and absorbing effect that suspended particles have on light. The principle behind the method is that a beam of light remains relatively undisturbed when transmitted through absolutely pure water; particles, when present, cause that light to be scattered and absorbed rather than transmitted.

The manner in which particles interfere with light transmittance is dependent on a number of factors, including the size, shape, number, composition, colour and refractive index of the particles, the wavelength (colour) of light that falls on them and the refractive index of the water. Although the interaction appears complex, an important generalization that can be made is that the intensity of the light scattering increases as the turbidity increases (APHA et al., 2012). Because so many factors affect the intensity of light scattering, it is not possible to relate turbidity measurements directly to the number, size or type of particles in the water.

Similar to bacteriological indicator measurements, turbidity measurements are valuable indicators of water quality. High turbidity measurements or measurement fluctuations can be indicative of inadequate water treatment or a problem with water quality (LeChevallier et al., 1981). The main benefits of using turbidity measurements as an indicator are that analysis is rapid and relatively inexpensive, and can be conducted continuously.

4.2 Sources

The sources and nature of turbidity are varied and complex and are influenced by the physical, chemical and microbiological characteristics of the water. Turbidity-causing particles in water can range in size from colloidal dimensions (0.001-1.0 µm) up to diameters on the order of 100 µm. In natural waters, particulate material arises mostly from the weathering of rocks and soils (Gregory, 2006). Significant contributions also come from human activities (e.g., sewage and wastewater releases). Inorganic clays and silts and natural organic matter (decomposed plant and animal substances) make up the most common particulate constituents of water. Other particles include inorganic precipitates, such as metal (iron or manganese) oxides and hydroxides; biological organisms, such as algae, cyanobacteria, zooplankton and filamentous or macroscopic

bacterial growths (i.e., biofilms); and naturally occurring asbestos minerals (Mackenthun and Keup, 1970; Kay et al., 1980). Products and materials that come into contact with drinking water during treatment (treatment additives and system components, such as filter materials, pipes, fittings and connections) can also have an effect on turbidity.

Turbidity has different implications for water quality and treatment depending on the nature of the particles involved and the location of the turbidity within the drinking water supply chain. An understanding of the type and source of the turbidity can be valuable when interpreting the impact of some turbidity-related issues. Table 1 summarizes some of the water quality and water treatment implications for different types of turbidity, and Table 2 summarizes some of the more common sources of turbidity.

Table 1: Turbidity type and implications for water quality and water treatment

Type of turbidity	Possible water quality/chemistry implications	Possible treatment implications
Inorganic particles		

Type of turbidity	Possible water quality/chemistry implications	Possible treatment implications
Clay, silt mineral fragments, natural precipitants (e.g., calcium carbonate, manganese dioxide, iron oxide)	Raise/lower pH and alkalinity • Source of micronutrients • Affect zeta potential • Source of metals and metal oxides • Cloudy/turbid appearance • Affect taste	• Major influence on coagulation, flocculation and sedimentation design • Harbour/protect microorganisms • May require chemical adjustments • Can precipitate in the distribution system
Organic particles		
Natural organic matter (decomposed plant and animal debris)	• Source of energy and nutrients for microorganisms • Cause colour	• Increased disinfectant demand • Harbour/protect microorganisms • Potential to form disinfection by-products

Type of turbidity	Possible water quality/chemistry implications	Possible treatment implications
Organic macromolecules	• Impart taste and odour • Possess ion exchange and complexing properties; association with toxic elements and micropollutants • Affect pH and zeta potential	• Potential to form disinfection by-products • Major influence on coagulation, flocculation and sedimentation design • Reduce filter runs • Can precipitate in the distribution system

Type of turbidity	Possible water quality/chemistry implications	Possible treatment implications
Microorganisms (algae, cyanobacteria, zooplankton, bacteria, protozoa)	• Impart taste and odour • Potential source of toxins (e.g., microcystin-LR) • Can cause microbiologically influenced corrosion in system • Stain fixtures • Aesthetic problems: sloughing of growths (tanks, filters, reservoirs, distribution system)	• Plug filters • Increased disinfectant demand • Need multiple barriers to ensure effective microbial inactivation • Biological growth (biofilm) • Shielding from disinfection

Table 2: Some common sources of turbidity within the drinking water supply chain

Component	Possible sources

GW (groundwater): groundwater; SW (surface water): surface water.

Component	Possible sources
Source water	• Surface runoff (SW/GUDI) • Natural weathering of rock formations (GW) • Resuspension of deposited sediment or settled solids (SW/GUDI, GW) • Waste discharges (sewage, wastewater) (SW/GUDI) • Blooms: cyanobacteria/algae (SW/GUDI) • Surface water recharge (GUDI) • Groundwater percolation (GW)
Treatment	• Treatment additives (e.g., coagulants, settling aids) (SW/GUDI) • Precipitation reactions (e.g., iron and manganese removal) (SW/GUDI, GW) • Fines from granular filter materials (SW/GUDI) • Incomplete particle removal during filtration (SW/GUDI, GW)

GW (groundwater): groundwater; SW (surface water): surface water.

Component	Possible sources
Distribution system	• Corrosion detachment (SW/GUDI, GW) • Scale detachment (SW/GUDI, GW) • Biological growth/biofilm detachment (SW/GUDI, GW) • Chemical reactions (e.g., precipitation reactions) (SW/GUDI, GW) • Sloughing of biological material from biofilters (SW/GUDI) • Sediment resuspension (SW/GUDI, GW) • Intrusion/main breaks (SW/GUDI, GW)

GW (groundwater): groundwater; SW (surface water): surface water.

← Previous Page | Table of Contents | Next Page →

Date modified:
2014-02-05